437th Airlift Wing Charleston AFB, South Carolina

MID-AIR COLLISION AVOIDANCE

February 2009

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- Click on <MACA Handbook>

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 437TH AIRLIFT WING (AMC)

SEP 28 2007

MEMORANDUM FOR LOW COUNTRY AVIATORS

FROM: 437 AW/CC
102 East Hill Blvd., Suite A
Charleston AFB, SC 29404-5004

SUBJECT: Mid-Air Collision Avoidance

1. **Safe mission accomplishment is my #1 priority**. As the Wing Commander at Charleston Air Force Base (AFB), I am responsible for the operation of the largest C-17 wing in the Air Force. To perform our mission, we must integrate military flight operations with commercial and general aviation traffic of all types and sizes. We need your help in this dynamic process.

2. With over 50 civilian airfields located in the vicinity of Charleston AFB, the sky over the Low Country can be a busy place to be. Each year local airspace becomes more saturated. The key to avoiding hazards associated with this high traffic volume is awareness.

3. This brochure was designed to familiarize you with where and how our aircraft operate in this area. I encourage you to become aquainted with the location of our Military Training Routes and practice areas depicted inside. Also included are telephone numbers and agencies to contact if you have any questions, suggestions, or encounter problems with the operations at Charleston AFB. I think you will find this information useful for flight in the Charleston area. Through awareness, vigilance, and teamwork, we can make the Low Country a safer place to fly.

JOHN C. MILLANDER, Colonel, USAF
Commander

CHARLESTON AFB, SC

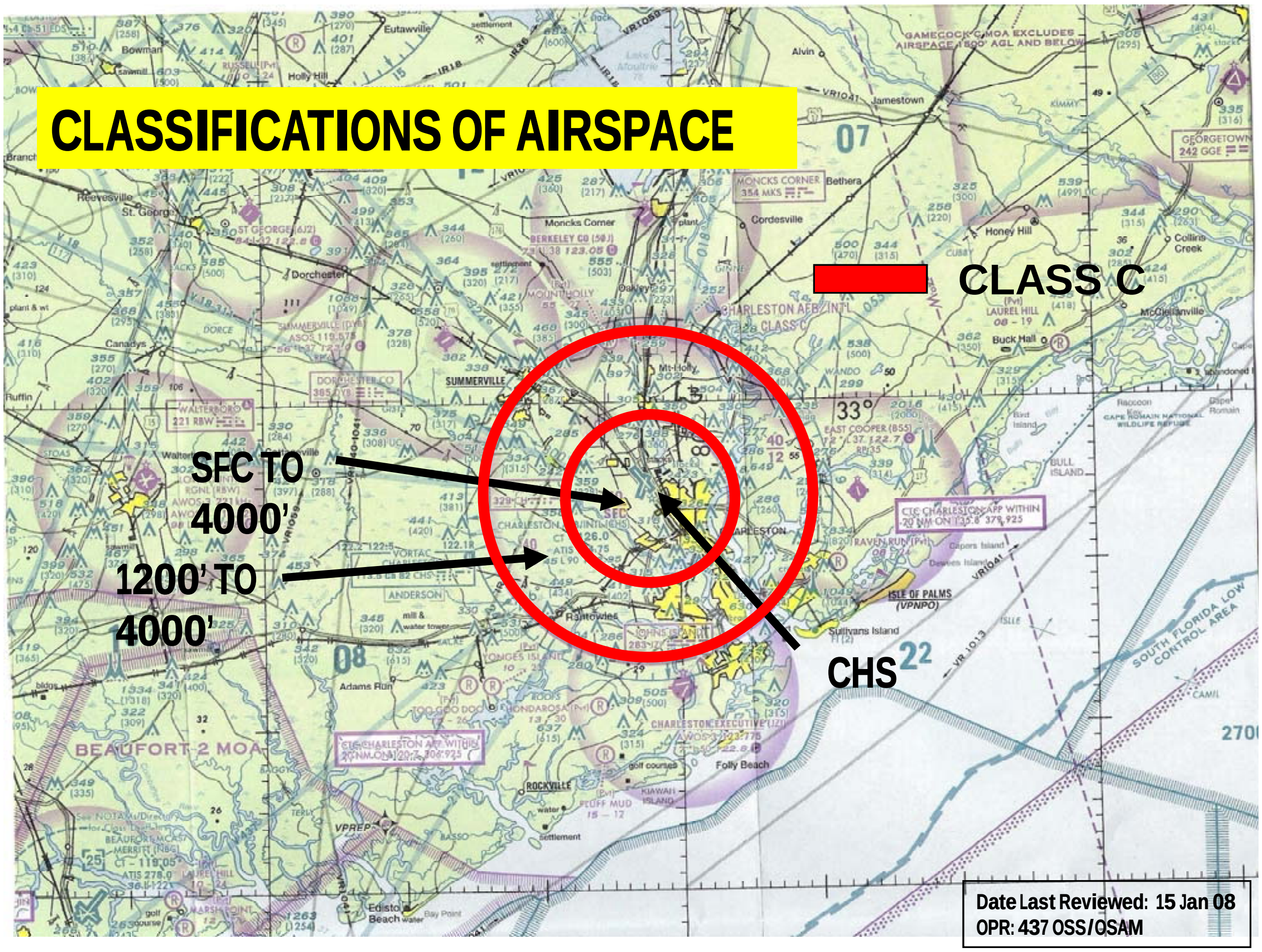
Charleston Air Force Base is part of the Air Mobility Command, a worldwide network of bases transporting people and equipment to combat locations. The base is located 16 miles northwest of the peninsular city of Charleston, South Carolina. It is a joint-use airfield meeting the needs of both the United States Air Force and the local Charleston community.

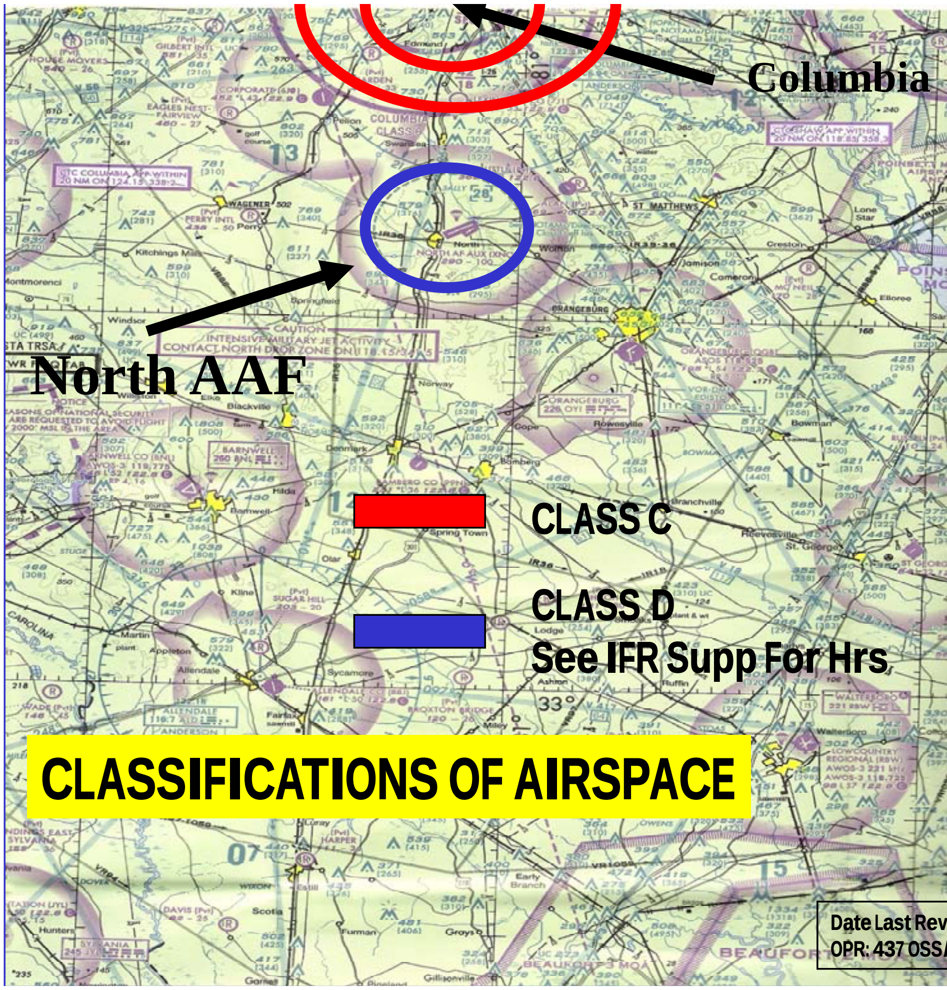
The base is home to the 437th Airlift Wing (AW) and the 315th Airlift Wing (USAF Reserve). These are strategic airlift units with over 50 C-17A Globemaster III aircraft.

There are approximately 50 civilian airfields around the Charleston AFB area. Commercial air carriers, executive aircraft, and general aviation aircraft extensively use Charleston International Airport. The aircraft found in the local airspace range from ultra-light aircraft to supersonic fighters to heavy airlifters.

<u>The potential for a mid-air collision is high!</u>

CHARLESTON CLASS “C” AIRSPACE





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TRAFFIC PATTERN ALTITUDES
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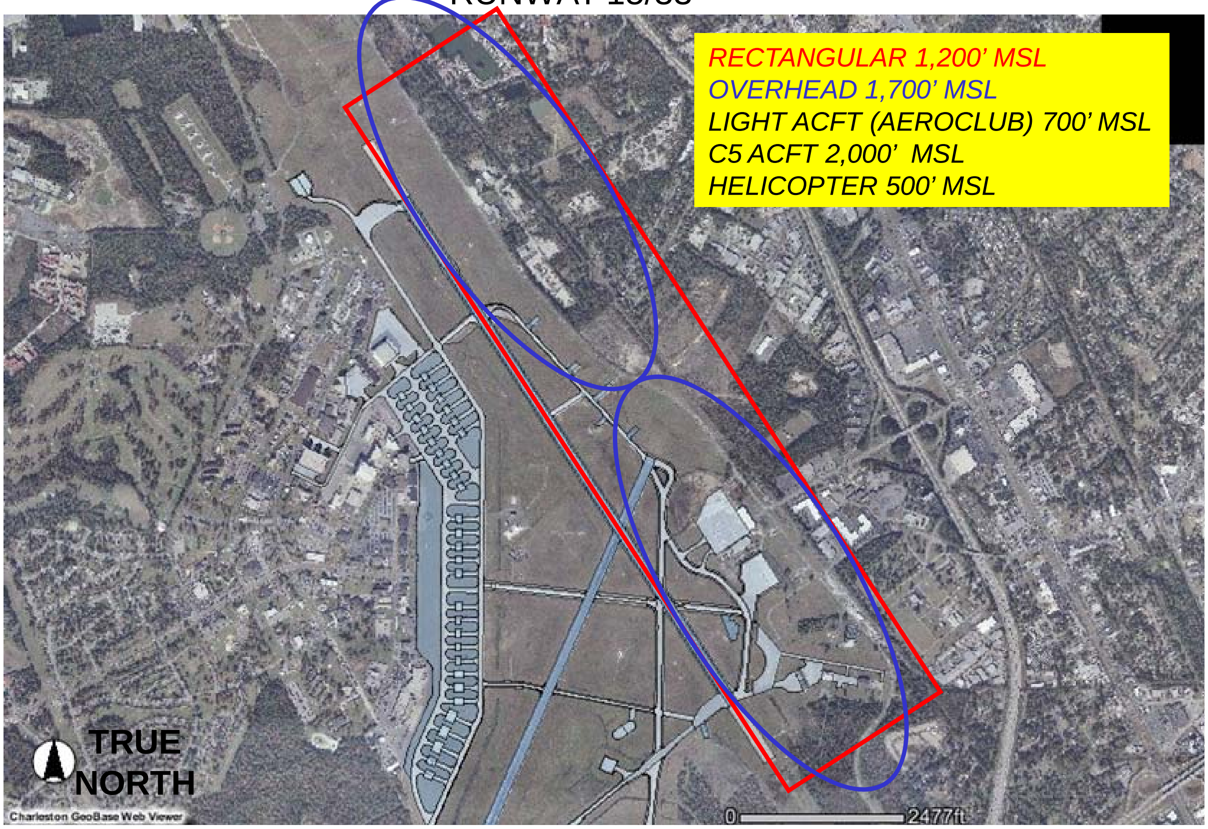

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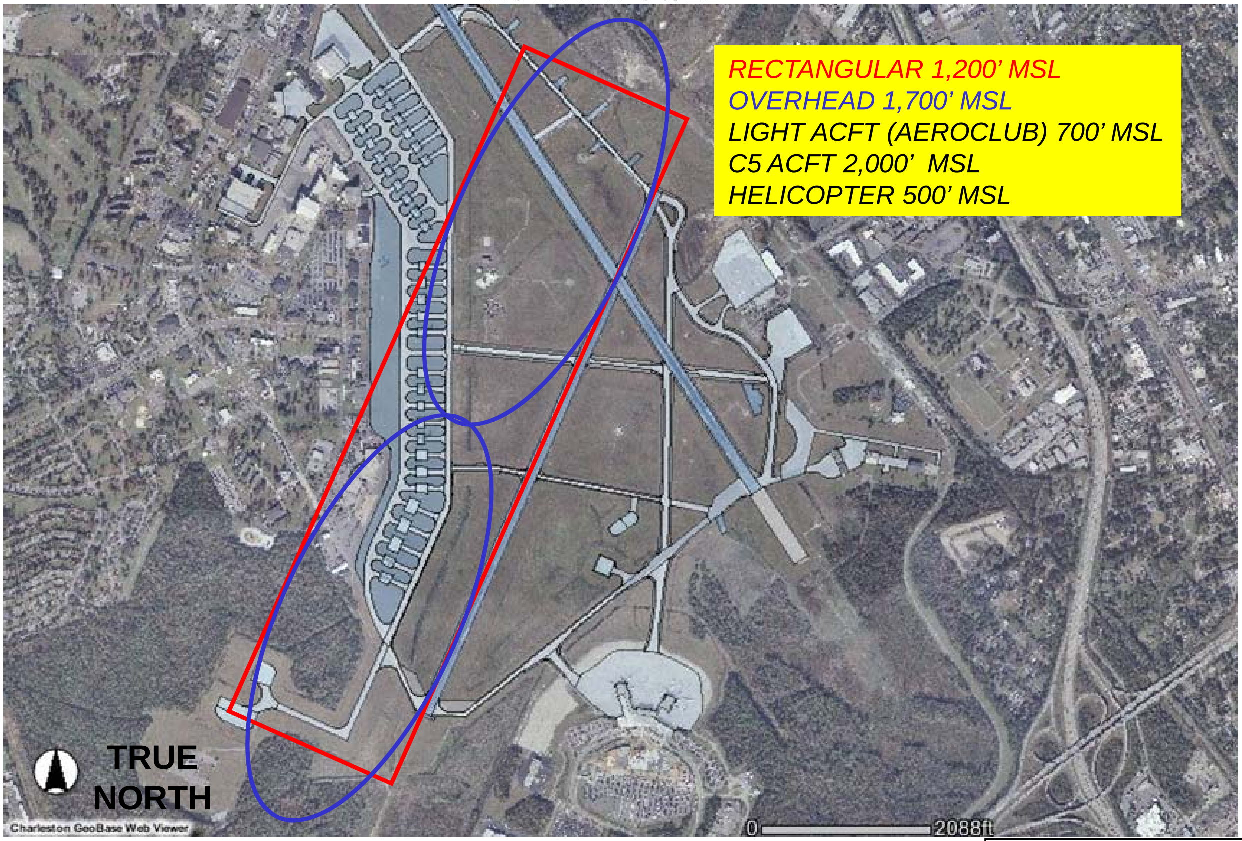

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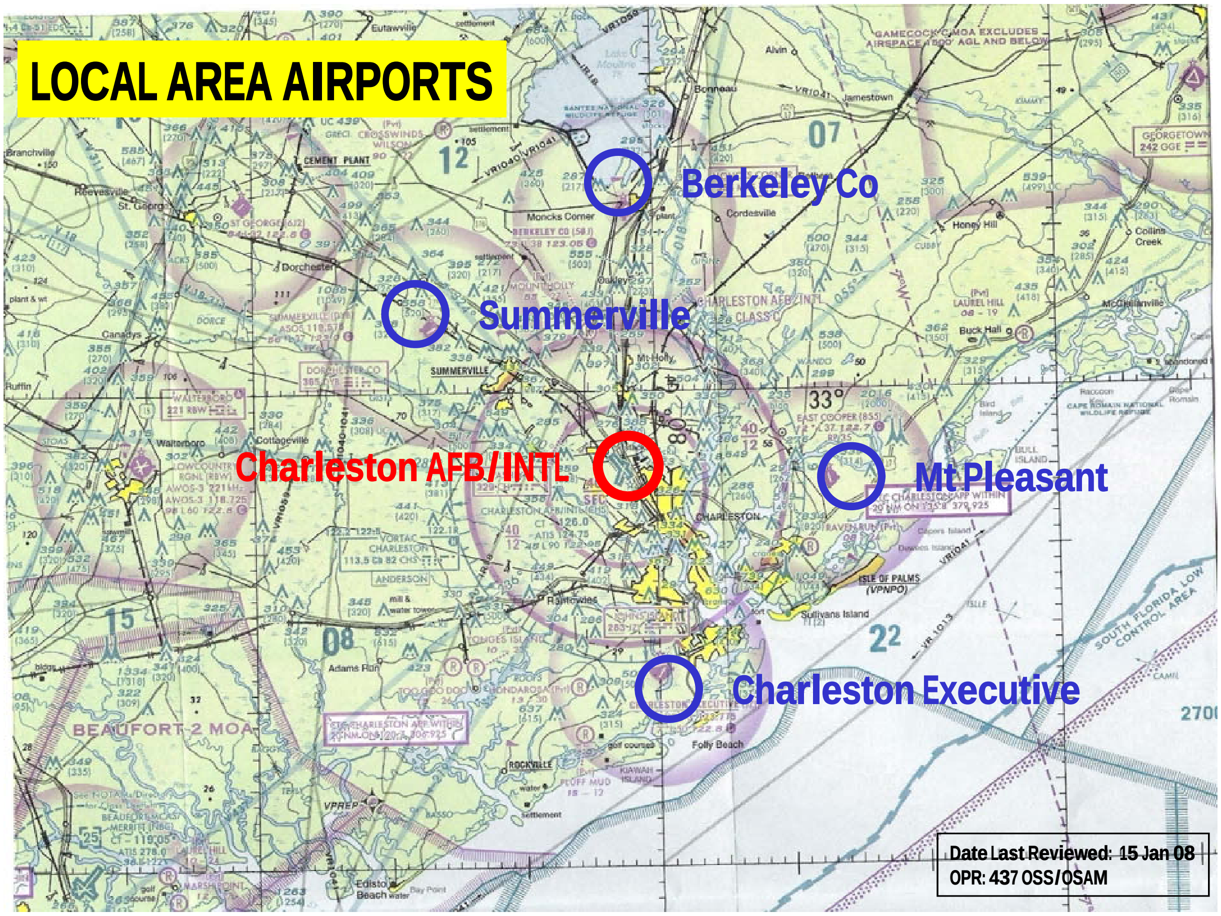
LOCAL AREA AIRPORTS
Berkeley Co
Summerville
Charleston AFB/INTL
Mt Pleasant
Charleston Executive
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LOCAL AREA AIRPORTS

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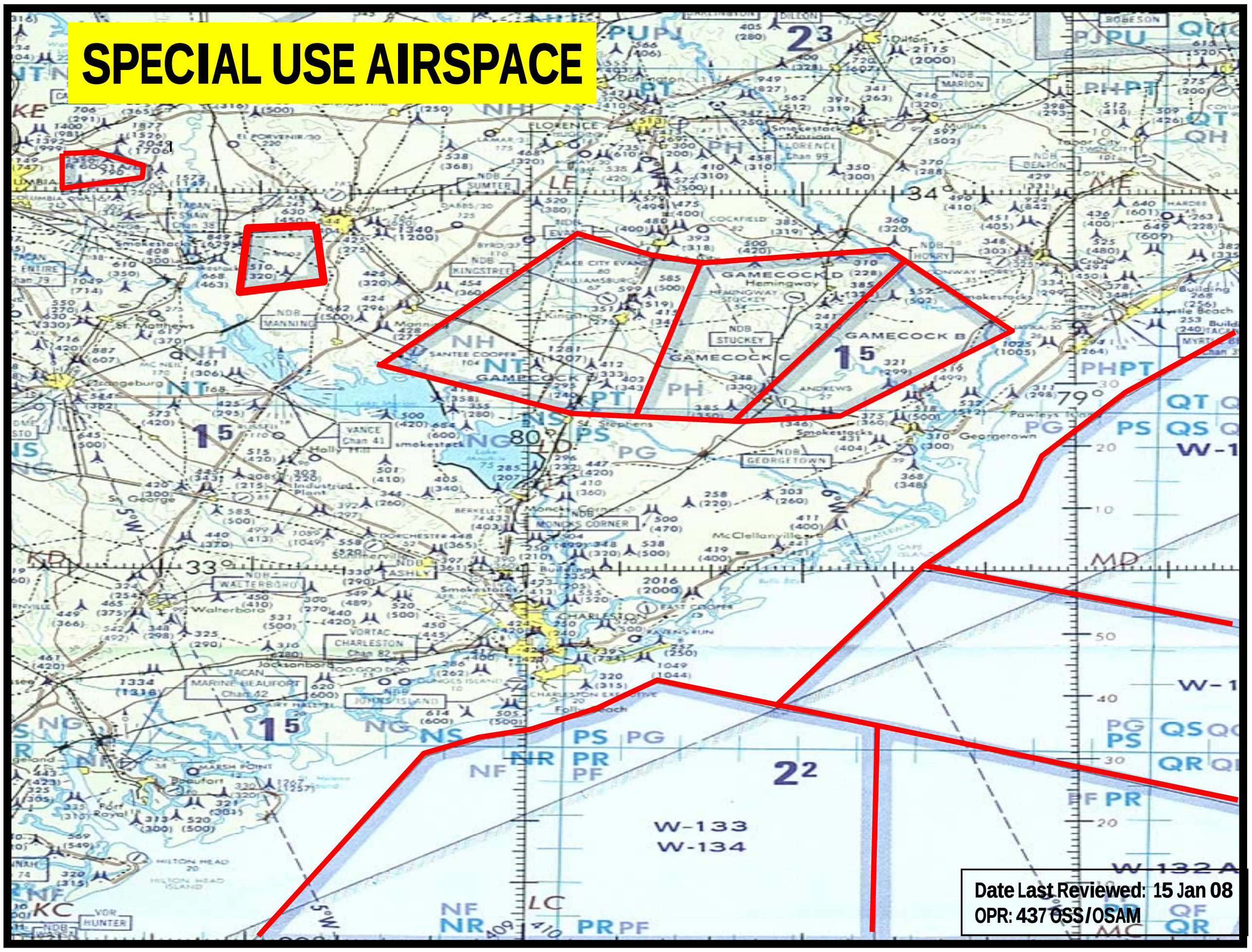
SPECIAL USE AIRSPACE



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NORTH AUXILIARY AIRFIELD

North Auxiliary Airfield is located approximately 15 NM south of the Columbia VORTAC. Extensive C-17 activities are conducted 24 hours a day, 7 days a week at this airfield. The airspace in the immediate vicinity of North Field is Class G airspace; however it does have a non-FAA manned control tower. If you need to transit through the airspace surrounding North Field, you can advise the control tower on **118.15** with your intentions. If you are unable to reach anyone, broadcast your position and intended route of flight in the blind on this radio frequency so traffic operating there will be aware of your location.


Charleston AFB Geo Integration Office
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MID-AIR COLLISION AVOIDANCE

Charleston International Airport (Charleston AFB) is designated Class C airspace. Every aircraft must be in contact with Charleston Approach Control (East-135.8; West-120.7) before entering this area.

To use the radar service, contact Approach control on 120.7 when approaching from the south or west and 135.8 when arriving from the north or east. Establish and maintain two-way radio communication with ATC prior to entering the airspace. Radio contact must be maintained while within the airspace.

The best way to avoid a mid-air collision is to stay alert. It helps to know where to look for traffic and what to look for. We're monitoring the same frequencies you are and we'll be looking and listening for you!

Pilots should be especially alert for C-17 jet traffic when flying within 15 nautical miles of Charleston AFB since training is conducted 24 hours a day throughout the year. You can expect to see our aircraft frequently at altitudes of 4,000 ft MSL and below conducting visual and instrument procedures.

A later section in this guide explains and graphically depicts C-17 low-level military training routes (MTRs). At various times of the day and night you may see up to nine of our large aircraft in formation at your altitude on these routes.

MID-AIR COLLISION CAUSES AND CONDITIONS

1. Generally occurred during daylight hours.
   - ✈ 56% of the accidents occurred in the afternoon.
   - ✈ 32% of the accidents occurred in the morning.
   - ✈ 2% of the accidents occurred at night, dusk, or dawn.

2. Most occurred in weather conditions when the visibility was acceptable (i.e., three miles or more).

3. No pilot is immune. Experience levels ranged from initial solo pilots to 15,000-hour veterans.

4. The majority occurred below 8,000 feet MSL and near airports, NAVAIDS, and other high-density traffic areas.

5. Flight instructors were aboard one of the aircraft in 37 percent of the cases.

6. The majority of the aircraft involved in collisions are not on any type of flight plan.

7. Nearly all accidents occur at or near uncontrolled airports and at altitudes below 1000 ft.

8. Flight fatigue (fatigue resulting directly from flight related operations) is not a major factor in most mid-air collisions.
   - ✈ The average flight time prior to the collision is 45 minutes.
   - ✈ 60% of the pilots on the mishap flight had been airborne thirty minutes or less.
   - ✈ Only 6% had been flying longer than two hours.

Let’s look at some factors involved in preventing two aircraft from occupying the same space at the same time:

- Detection of objects.
- Physiological factors.
- ATC environment.

DETECTION OF OBJECTS

Detection of objects while airborne depends on six conditions:
(1) ***Image size*** **-** portion of the visual field filled by the object
(2) ***Luminance*** **-** degree of brightness of the object
(3) ***Contrast*** **-** difference between object and background brightness, color, and shape
(4) ***Adaptation*** **-** degree to which the eyes adjust to surrounding illumination
(5) ***Motion*** **-** velocity of the object, the observer, or both
(6) ***Exposure time*** **-** length of the time the object is exposed to view

IMAGE SIZE

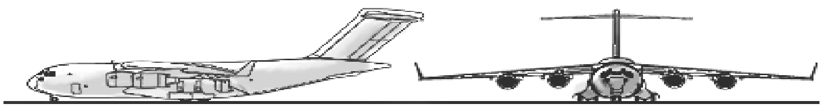
An aircraft seen at long range appears not as an identifiable shape but rather as a dark dot. Aircraft detection is different depending on whether it is day or night. During the day, the further the object falls from the fovea (center of vision), the larger the image must be to be noticed. At night, detection is sometimes superior if the target image falls on the peripheral retina (off center), rather than the fovea. An example is the phenomenon of dim light disappearing as the observer looks directly at it and reappearing when looked at peripherally.

LUMINANCE AND CONTRAST

Luminance and contrast are basically one in the same. An object is more visible when it is sufficiently brighter or darker than its background – in other words, there is contrast.

In addition to brightness and contrast, color and shape differences offer visual cues to detect aircraft. When an object and background have contrasting colors (yellow and blue, green and red, black and white), detection becomes easier.

Similarly, when objects are long and thin as opposed to round and flat, they are easier to detect. An aircraft seen in profile is easier to notice than a head-on aircraft of equal area.



ADAPTATION

The eye requires at least 30 minutes in darkness to distinguish objects under low illumination. Conversely, when the eyes have been accustomed to darkness, they need to adapt to bright light.

MOTION

Against a stationary irregular background, an aircraft needs only to move a few minutes of arc-per-second to reveal its presence to an alert observer. However, against a featureless background, like a cloudless blue sky, the aircraft's perceived motion must be 10 times faster to be noticed. What complicates the detection of relative motion is the fact that while flying, your eyes are also constantly moving.

EXPOSURE TIME

An aircraft that darts in and out of clouds presents a special challenge to the viewer. When an aircraft is not continuously exposed to view, the pilot has to judge its speed and direction in order to follow its path behind a cloud or the horizon. A small, slow-moving object that presents little contrast against its background can be easily lost during intermittent observation.

PHYSIOLOGICAL FACTORS

As your eyes become fatigued, they grow less efficient at the task of seeing airborne aircraft. Only well-rested eyes can assure good vision. Structural parts, windshield/canopy distortion, poor cockpit lighting, dirty windshield, and instrument glare can limit a pilot's vision even further.

Complete darkness, fog, total overcast, and cloudless blue skies all present the viewer with a monotonous field. In such conditions, normal eyes constantly try to focus on infinity by actually focusing on a point 1 to 2 meters away. This is called search myopia and reduces the pilot's chances of seeing a distant aircraft.

Try to focus on objects at the maximum range you expect to see aircraft-focus on the ground at about 4 to 8 NM and move your gaze up to the sector of the sky to be searched. Attempt to avoid frequent re-focusing in and out of the cockpit. About one-third of a second is required for the eyes to focus at each fixation. Your airborne searching scan should be slow and methodical. Learn to scan the visual field by dividing the area up into sectors, about 30 degrees each. Fix your gaze in that sector for a second or two. Investigate any movement, then move to the next sector. If you have trouble focusing at long ranges, try squinting. Squinting compresses the eyeball and changes its focal length allowing long-range aircraft to come in focus.

At lower altitudes the easiest aircraft to see is on the horizon. Shadows sometimes help pilots to detect another aircraft. To spot the aircraft, look from the shadow to the sun. The lower the aircraft, the closer it is to its shadow.

LOCATING YOUR BLIND SPOT

a. With the right eye closed, look at the right of the upper figure. Move the paper back and forth about one foot from the eyes; the circle on the left will disappear. At that point it is projected on the blind spot.
b. With the right eye closed, look at the cross at the right of the lower figure. When the white space falls in the blind spot, the black line appears to be continuous. This phenomenon helps us understand why we are not ordinarily aware of the blind spot.

It is important to realize that all of us have blind spots. The potential for a mid-air collision lies within this blind area. At one mile this area could be 800 feet by 500 feet and at 5 miles the area may be 4/5 of a mile. The blind spot will vary depending on aircraft type and different face structures. A way to compensate for the blind spot is to move the head around while looking and look more than once in a given direction.

GUIDE TO AN EFFECTIVE SCAN

Your best defense against midair collisions is an effective scan pattern. There is no perfect scan, and no single scan technique that is best for all pilots. The most important thing is for each pilot to develop a scan that is both comfortable and workable.

The first step to scanning properly is knowing where to concentrate your search. Instead of trying to look everywhere, concentrate on the areas most critical to you at any given time. In the traffic pattern especially, clear yourself before every turn and always watch for other traffic coming into the pattern. On descent and climb out, make gentle S-turns to see if anyone is in your way. Also make clearing turns before attempting maneuvers such as pylons and S-turns about a road. During the very critical final approach stage, do not forget to look behind and below to avoid tunnel vision. Pilots often rivet their eyes to the point of touchdown.

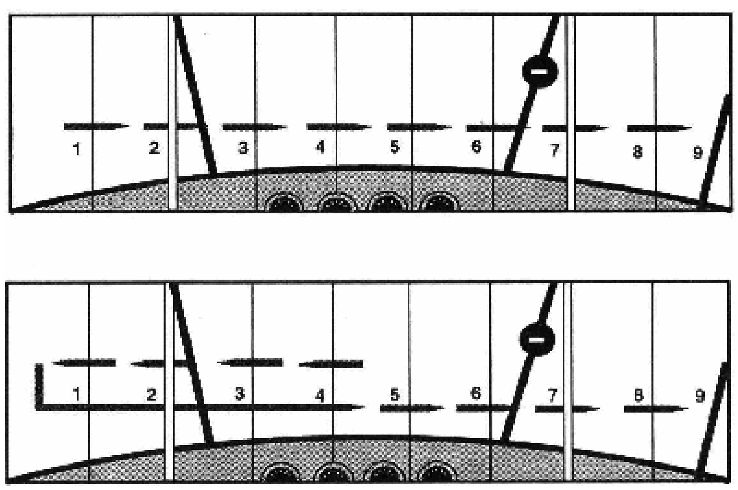
In normal flight, you can generally avoid the threat of a midair collision by scanning 60 degrees to the left and right of your central viewing area. Vertically, you will be safe if you scan 10 degrees up and down from your flight vector. This will allow you to spot any aircraft that might prove hazardous to your own flight path, whether it is level with you, below and climbing, or above and descending. If another aircraft appears to have no relative motion, but is increasing in size, it is likely to be on a collision course with you.

SCAN PATTERNS

The scan that works best for most pilots is called the 'block' system. This type of scan is based on the theory that traffic detection can be made only through a series of eye fixations at different points in space. By fixating every 10-15 degrees, you should be able to detect any contrasting or moving object in each block. This gives you 9-12 blocks in your scan area, each requiring a minimum of one to two seconds for acclimation and detection.

One method of block scanning is the 'side-to-side' motion (top picture). Start at the far left of your visual area and make a methodical sweep to the right, pausing in each block to focus. At the end of the scan, return to the instrument panel. A second form of block scanning is the 'front-to-side' version (bottom picture). Start with a fixation in the center block of your visual field. Move your eyes to the left, focusing in each block, swing quickly back to the center block, and repeat performance to the right.

There are other methods of scanning, but unless some series of fixations are made, there is little likelihood that you will be able to detect all targets in your scan area. When the head is in motion, vision is blurred and the mind will not register targets as such.

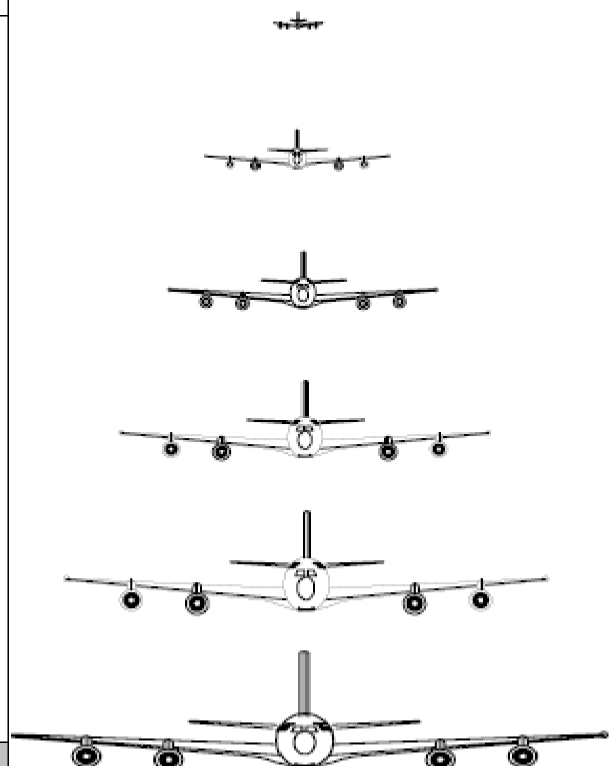


Developing an efficient scan takes a lot of work and practice, but it is just as important as developing good landing techniques. The best way is to start on the ground, in your own airplane, or the one you usually fly, and then practice your scan during every flight.

AIRCRAFT CLOSURE RATE CHART

Based on the combined speeds of two aircraft.

Distance	Seconds At 600 MPH	Seconds At 210 MPH
10 miles	60	170
5 miles	30	85
3 miles	18	56
2 miles	12	38
1 mile	6	18
.5 mile	3	9



Taking into account the recognition and reaction times shown in the table; the shaded blocks in the chart above indicate distances where aircraft on a collision course would surely collide.

NEAR MIDAIR COLLISION REPORTING

Definition: A near midair collision (NMAC) as defined by the **AIM (7-6-3)** is *"an incident associated with the operation of an aircraft in which a possibility of collision occurs as a result of proximity of less than 500 feet to another aircraft, or a report is received from a pilot or a flight crew member stating that a collision hazard existed between two or more aircraft."*
Although the AIM mentions a definitive 500-foot proximity in this definition, it goes on to allow the pilot or flight crew member to make a determination as to if a collision hazard existed regardless of how close the aircraft came to one another. Therefore, use your judgment and make an honest assessment. If you believe a collision hazard existed, report it. It's your responsibility!

Reporting a NMAC: First of all, you must inform ATC by using the following verbiage. ***"I wish to report a near midair collision."*** This is in accordance with the **AIM 7-6-3**. A "Man that was close!" will not necessarily convey your intent. Properly notifying ATC will ensure the necessary data is saved. NMACs are reported on **FAA Form 8020-21**, "Preliminary Near Midair Collision Report," and should contain the following information:

• Date, time, and location of the NMAC
• Fix or facility nearest the NMAC
• The NMAC location in respect to the fix or facility
• Aircraft information, such as make, model, and registration number
• Type of flight rules during the NMAC
• The aircraft altitude during the NMAC
• A brief description of the NMAC, along with comments
• Aircraft altitude when the deviation was detected
• A brief description of the deviation, with appropriate comments

Your participation in the reporting process is highly encouraged and essential for improvements in the air traffic system and mishap prevention.

Recent years have shown a reduction in NMAC reporting. This does not necessarily mean a reduction of incidents, just a reduction in reporting. Therefore, a reduction in reporting should not lull anyone into a false sense of security that the threat of a midair collision is any less real. Why then are fewer NMACs reported? The following excerpt provides an explanation: *"The reporting of a Near Midair Collision is voluntary and depends in part on the individual's perception of a situation. A report does not necessarily involve the violation of regulations or an error by air traffic controllers, nor does it necessarily represent an unsafe condition. Significant factors influencing the submission of a report may include the proximity of the aircraft involved, the element of surprise in the encounter, or the heightened alertness of the flight crew to the possibility of a Near Midair Collision because of the publicity surrounding a near, or actual, midair collision. Some Near Midair Collisions, including those which may involve unsafe conditions, may not be reported. Some reasons are the failure to see the other aircraft or to perceive accurately the distance from another aircraft due to restricted visibility or the relative angle of approach. Others are the fear of penalty, or lack of awareness of the*

NMAC reporting system." (Aviation Safety Statistical Handbook - October 2002) Your participation in the reporting process is highly encouraged and essential for improvements in the air traffic system and mishap prevention.

Aviation Safety Reporting System (ASRS)

The FAA initiated ASRS in 1975 and provides the necessary funding. In order to maintain objectivity and anonymity, NASA sets policies and administers the program through a private contractor obtained through competitive bidding. The current contractor is Battelle Memorial Institute. Reports sent to the ASRS are held in strict confidence. More than 300,000 reports have been submitted to date and no reporter's identity has ever been breached by the ASRS. ASRS de-identifies reports before entering them into the incident database. All personal and organizational names are removed. Dates, times, and related information, which could be used to infer an identity, are either generalized or eliminated. The FAA will not use information obtained through ASRS for enforcement actions. If the FAA has information from other sources concerning violations they will take appropriate action. However, because they consider the filing of a "NASA" report as "indicative of a constructive attitude" and that such an attitude tends to "prevent future violations" **(Advisory Circular 00-46D)**, the FAA won't impose any civil penalties or certificate suspensions. You must meet the following criteria to be eligible for immunity:

• Violation was not deliberate
• Not a criminal offense
• No mishap occurred
• No violation within five years prior to the date of occurrence
• Incident was properly reported.

Within 10 days after the violation, complete and deliver or mail a written report of the incident or occurrence to NASA under ASRS Obtain ASRS report forms and additional information from http://asrs.arc.nasa.gov. Bottom line – ASRS promotes aviation safety and offers immunity from disciplinary action, a win – win situation. Please consider using this reporting system. **NOTE:** Tragic events are usually preceded by warnings, such as close calls, almost accidents or accidents/incidents in which tragedy was narrowly averted. These close calls need to be reported, recorded, communicated, and in many instances investigated to prevent future tragedies from occurring. It is every aviator's responsibility, for the good of humanity and the promotion of aviation to detect, report, and eliminate potential hazards

AIR TRAFFIC CONTROL ENVIRONMENT

RADAR

The continuing development of more sophisticated and automated equipment has given rise to the notion among some airmen that controllers are watching their every move en route and will always be able to warn other aircraft, particularly those flying IFR, of their presence. This misconception is deadly.

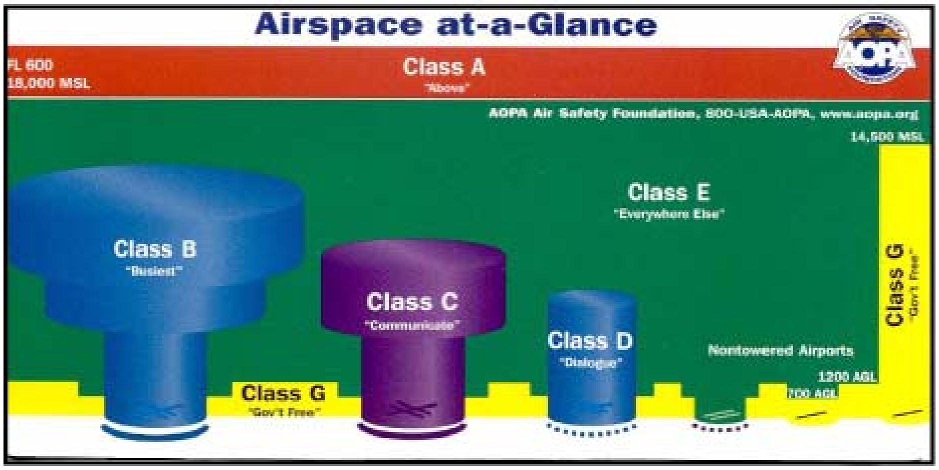
The adoption of radar for air traffic control brought with it a series of increased capabilities. Radar's added capability encourages some of us to overlook the fact that current radar is not all encompassing in its coverage, radar does not pick up all aircraft at all times, and radar is primarily used to separate IFR traffic.

As radar found its way into air traffic control, ground clutter became an increasingly serious problem for terminal radar. Some of today's most sophisticated black box circuitry is aimed at reducing this phenomenon. Modern radar does a magnificent job compared to the old days, but clutter is still there. One way of reducing ground clutter to a minimum is to weaken radar's sensitivity to distant aircraft targets. The person affected in this trade-off is the pilot flying an airplane with the weakest radar-reflecting properties. This group includes many small general aviation airplanes flying IFR without active transponders. In some situations, these aircraft are not "painted" on the radarscope even though they are within range of the transmitter.

SECURITY BLANKET

Some pilots think of IFR as a security blanket. They say to themselves, "I'm on an IFR flight plan, so air traffic control will tell me about all the traffic I might encounter." So they settle back in their seat feeling safe. There are examples of mid-air collisions involving IFR and VFR aircraft and even between IFR aircraft to dispel this myth.

AIRSPACE AROUND CHARLESTON AFB



CLASS C AIRSPACE

a. Definition: Generally, that airspace from the surface to 4,000 feet above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower, are serviced by a radar approach control, and that have a certain number of IFR operations or passenger enplanements. Although the configuration of each Class C airspace area is individually tailored, the airspace usually consists of a 5 NM radius core surface area that extends from the surface up to 4,000 feet above the airport elevation, and a 10 NM radius shelf area that extends from 1,200 feet to 4,000 feet above the airport elevation.

b. Outer Area: The normal radius will be 20NM, with some variations based on site specific requirements. The outer area extends outward from the primary airport and extends from the lower limits of radar/radio coverage up to the ceiling of the approach control's delegated airspace, excluding the Class C airspace and other airspace as appropriate.

c. Charts: Class C airspace is charted on Sectional Charts, IFR En Route Low Altitude, and Terminal Area Charts where appropriate.

d. Operating Rules and Pilot/Equipment Requirements:

1. *Pilot Certification:* No specific certification required.

2. *Equipment:*

(a) Two-way radio, and

(b) Unless otherwise authorized by ATC, an operable radar beacon transponder with automatic altitude reporting equipment.

3. *Arrival or Through Flight Entry Requirements:* Two-way radio communication must be established with the ATC facility providing ATC services prior to entry and thereafter maintain those communications while in Class C airspace. Pilots of arriving aircraft should contact the Class C airspace ATC facility on the publicized frequency and give their position, altitude, radar beacon code, destination, and request Class C service. Radio contact should be initiated far enough from the Class C airspace boundary to preclude entering Class C airspace before two-way radio communications are established.

e. Air Traffic Services: When two-way radio communications and radar contact are established, all participating VFR aircraft are:

1. Sequenced to the primary airport.
2. Provided Class C services within the Class C airspace and the outer area.
3. Provided basic radar services beyond the outer area on a workload permitting basis. This can be terminated by the controller if workload dictates.

CLASS D AIRSPACE

a. Definition: Generally, that airspace from the surface to 2,500 feet above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower. The configuration of each Class D airspace area is individually tailored and when instrument procedures are published, the airspace will normally be designed to contain the procedures.

b. Operating Rules and Pilot/Equipment Requirements:

1. *Pilot Certification:* No specific certification required.
2. *Equipment:* Unless otherwise authorized by ATC, an operable two-way radio is required.
3. *Arrival or Through Flight Entry Requirements:* Two-way radio communication must be established with the ATC facility providing ATC services prior to entry and thereafter maintain those communications while in the Class D airspace. Pilots of arriving aircraft should contact the control tower on the publicized frequency and give their position, altitude, destination, and any request (s). Radio contact should be initiated far enough from the Class D airspace boundary to preclude entering the Class D airspace before two way radio communications are established.

c. Charts: Class D airspace areas are depicted on Sectional and Terminal charts with blue segmented lines, and on IFR En Route Lows with a boxed [D].

d. Operating Rules and Pilot/Equipment Requirements:

Arrival extensions for instrument approach procedures may be Class D or Class E airspace. As a general rule, if all extensions are 2 miles or less, they remain part of the Class D surface area. However, if any one extension is greater than 2 miles, then all extensions become Class E.

e. Separation for VFR Aircraft: No separation services are provided to VFR aircraft.

CLASS E AIRSPACE

a. Definition: Generally, if the airspace is not Class A, Class B, Class C, or Class D, and it is controlled airspace, it is Class E airspace.

b. Operating Rules and Pilot/Equipment Requirements:
1. *Pilot Certification:* No specific certification required.
2. *Equipment:* No specific equipment required by the airspace.
3. *Arrival or Through Flight Entry Requirements:* No specific requirements.

c. Charts: Class E airspace below 14,500 feet MSL is charted on Sectional, Terminal, World, and IFR En Route Low Altitude charts.

d. Vertical limits: Except for 18,000 feet MSL, Class E airspace has no defined vertical limit but rather it extends upward from either the surface or a designated altitude to the overlying or adjacent controlled airspace.

e. Separation for VFR Aircraft: **No separation services are provided to VFR aircraft.**

VFR Weather Minimums		
Airspace	**Visibility**	**Cloud Distance**
Class C, D	3 statute miles	500 feet below 1,000 feet above 2,000 feet lateral
Class E Less than 10,000 ft MSL	3 statute miles	500 feet below 1,000 feet above 2,000 feet lateral
Class E At or above 10,000 ft MSL	5 statute miles	1,000 feet below 1,000 feet above 1 stat. mile lateral
Class G 1,200 ft or less AGL		
Day	1 statute mile	clear of clouds
Night	3 statute miles	500 feet below 1,000 feet above 2,000 feet lateral
Class G > 1,200 ft AGL but < 10,000 ft MSL		
Day	1 statute mile	500 feet below 1,000 feet above 2,000 feet lateral
Night	3 statute miles	500 feet below 1,000 feet above 2,000 feet lateral

RIGHT-OF-WAY RULES

Pilots need to be extremely familiar with the right of way rules outlined in **14 CFR Sections 91.113** and **91.115**. Because every second counts when maneuvering to avoid a midair collision, reacting properly must be second nature *"Pilots should be familiar with rules on right-of-way, so if an aircraft is on obvious collision course, one can take immediate* evasive action, preferably in compliance with applicable Federal Aviation Regulations." **(AIM 8-1-8. Judgment Aspects of Collision Avoidance, paragraph c. Taking Appropriate Action)** Here as stated in the FARs are the right-of-way rules:
Section 91.113: Right-of-way rules: Except water operations.

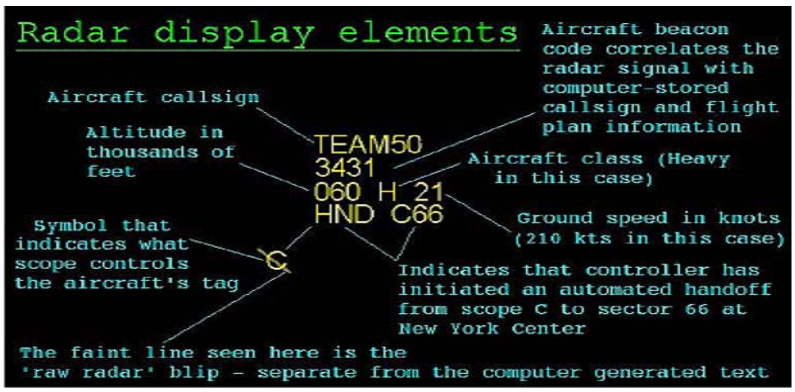
(a) *Inapplicability*. This section does not apply to the operation of an aircraft on water.
(b) *General.* When weather conditions permit, regardless of whether an operation is conducted under instrument flight rules or visual flight rules, vigilance shall be maintained by each person operating an aircraft so as to see and avoid other aircraft. When a rule of this section gives another aircraft the right-of-way, the pilot shall give way to that aircraft and may not pass over, under, or ahead of it unless well clear.
(c) *In distress.* An aircraft in distress has the right-of-way over all other air traffic.
(d) *Converging.* When aircraft of the same category are converging at approximately the same altitude (except head-on, or nearly so), the aircraft to the other's right has the right of-way. If the aircraft are of different categories --

> (1) A balloon has the right-of-way over any other category of aircraft;
> (2) A glider has the right-of-way over an airship, airplane, or rotorcraft; and
> (3) An airship has the right-of-way over an airplane or rotorcraft. However, an aircraft towing or refueling other aircraft has the right-of-way over all other engine-driven aircraft.

(e) *Approaching head-on.* When aircraft are approaching each other head-on, or nearly so, each pilot of each aircraft shall alter course to the right.
(f) *Overtaking.* Each aircraft that is being overtaken has the right-of-way and each pilot of an overtaking aircraft shall alter course to the right to pass well clear.
(g) *Landing.* Aircraft, while on final approach to land or while landing, have the right of way over other aircraft in flight or operating on the surface, except that they shall not take advantage of this rule to force an aircraft off the runway surface which has already landed and is attempting to make way for an aircraft on final approach. When two or more aircraft are approaching an airport for the purpose of landing, the aircraft at the lower altitude has the right-of-way, but it shall not take advantage of this rule to cut in front of another which is on final approach to land or to overtake that aircraft.

WHO IS RESPONSIBLE?

The fact is that when operating in visual meteorological conditions (VMC), regardless of the type of flight plan you're on, the responsibility for seeing and avoiding other traffic rests with the pilot, not the controller. Civilian radar was developed primarily for the separation of IFR traffic from other IFR traffic. That is still the controller's primary responsibility although they will assist VFR traffic as much as time and facilities permit and call the pilot's attention to any known potential problem or immediate hazard. Radar advisory service for aircraft is specifically designated as a duty that follows the priorities of separation, safety advisories, and other required controller actions, and will be performed on a workload permitting bases only.



Depiction of aircraft information, provided by an aircraft's transponder, as displayed on the controller's screen.

What about the VFR day when you were level at 4,500 feet (certainly high enough to be in coverage), but Center missed telling you about the aircraft that nearly hit you! Traffic was light so you know the controller should have had time to help you.

There are days when the weather is "good" for flying but maybe not so good as far as the radar is concerned. Winds, temperatures aloft (particularly when inversions are present), narrow dew point spreads, and clouds all affect the amount of radar clutter, and/or reduce radar efficiency. This may occur where you or your traffic is located. In addition, the angle at which the radar antenna is tilted can result in some traffic not being seen at certain altitudes. Statistics show that the bulk of IFR traffic, the kind Center radar is primarily interested in, spends most of its time at relatively high altitudes while en route. This is the traffic that the en route radar is designed to monitor.

In terminal areas, the heaviest traffic is within 30 miles of the airport at altitudes varying with the location; again, the radar is focused for the area of greatest use. At 40 miles out you are in all likelihood within range of the radar signals, but the controller's scope may only be displaying targets closer in. Another factor to keep in mind is that there is virtually always a cone of non-coverage directly over radar antennae. All these things leave wide-open air spaces where there may be no radar coverage at various altitudes.

Certain kinds of aircraft are difficult to detect on radar. Smaller airplanes, those made in great part of materials other than metal, aircraft without propellers, and slow moving craft all have less reflective properties than others, resulting in less return of energy to the radar antenna. Consequently, the primary targets they produce are weak or nonexistent. An airplane also presents less of a target to the controller when it is flying directly toward or directly away from the radar antenna.

100 PERCENT CONCEPT

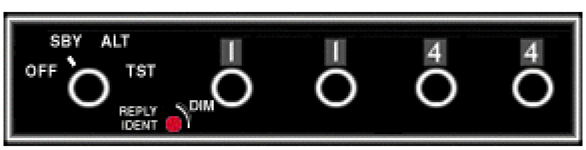
The concept of 100 percent radar coverage has to be understood in terms of stated goals, present and future. Questions asked at FAA "Listening Sessions" reveal that some pilots believe any time they hear "Radar Contact" the controller has taken over all separation responsibilities. At the very least, these pilots believe all air traffic in the area is shown on the controller's scope. This assumption can be fatal. Radar does not protect from unidentified aircraft or those that may not show up clearly on the radar scope. Unannounced VFR traffic that has entered into an IFR environment is an example of such a scenario.

Radar advisories are a very useful aid in helping the VFR pilot maintain separation. However, they are not to be regarded as evidence that a controller has taken over responsibility for such separation.

INCREASE AVAILABLE PROTECTION

How can radar best help you? Much of the problem could be solved by purchasing and using a transponder. The difference on the scope between a non-transponder equipped aircraft and one with a transponder would surprise you. Transponders make the size of the airplane irrelevant because transponder replies are the same size for a 747 or for a Piper Cub.

If you have a transponder, particularly with "MODE C" altitude reporting, use it. Many pilots turn the transponder off when leaving the terminal areas to "save" it or lengthen its operating life. There are two dangers in this practice. One danger is you become less visible to the controller's radar and other aircrafts' TCAS. The other is the possibility of forgetting to turn it back on at your destination. What good is saving component life while losing your own?



You can help the radar controller help you by not adding to his workload unnecessarily while he identifies your target. Remember that the controller may be looking at many unidentified blips on the scope. Always knowing where you are simplifies the task of establishing radar contact and shortens the time you are displayed as an "unknown."

VFR and IFR flight use similar concepts. Maintaining IFR means adhering to IFR altitudes and airspeeds while remaining within defined airspace such as the en route structure or terminal area and making the most of any traffic separation service available. When VFR, we maintain certain airspeeds, altitudes and area parameters such as in the traffic pattern and VFR hemisphere altitudes.

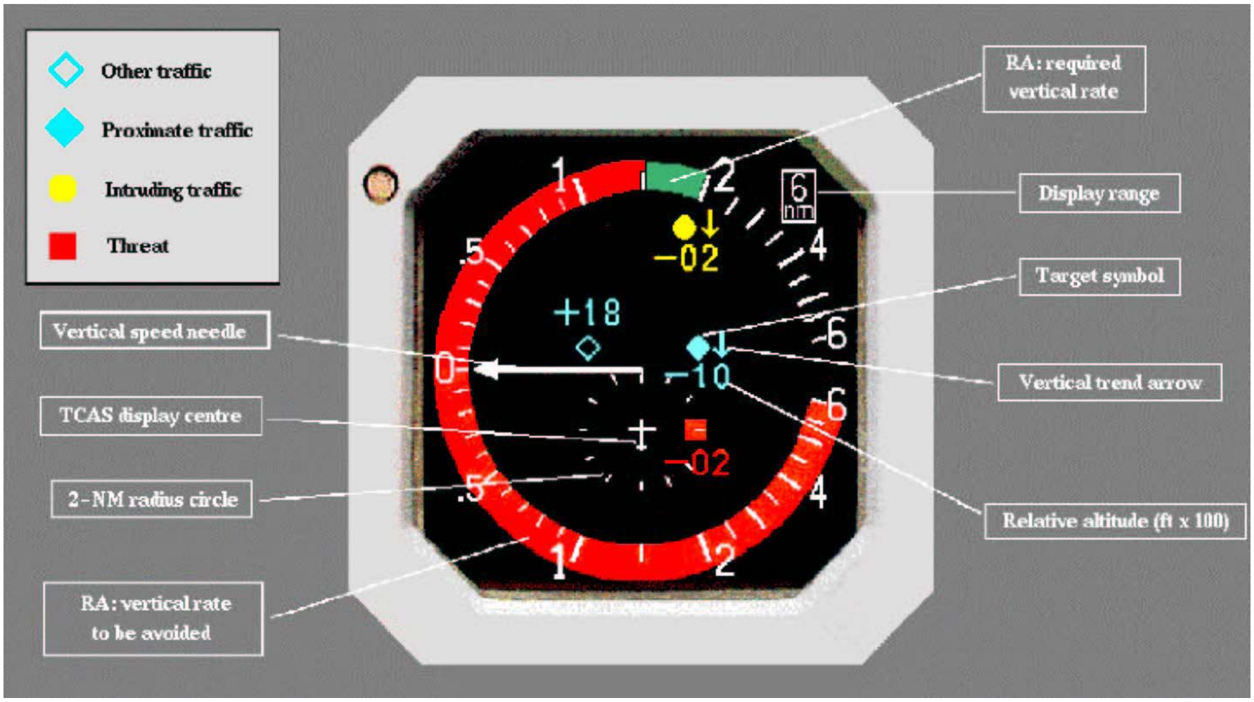
Pilots operating in VMC under IFR should be aware that they are in a "see and avoid" environment. Separation is provided only from other known aircraft operating within controller airspace.

Use extreme caution in the terminal area. This is where traffic density is greatest and where the mix of IFR and VFR traffic creates the greatest hazard. Flying a practice instrument approach in VFR conditions is fine, but it's not the time to keep your eyes glued to gauges. Even a radar monitor may not help; there are a lot of non-transponder equipped aircraft around that may not appear on the controller's scope. Don't get complacent, not even on final.

LISTEN

Along with looking, you need to listen. Improvements in radar systems as well as innovations such as Traffic Alert & Collision Avoidance Systems (TCAS) have made flying a little safer for everyone but any system has flaws. In instrument meteorological conditions, pay attention to the radios and keep up with the traffic situation in your area.

There is also a new and free service provided by the FAA that enables GA pilots to see other traffic in their vicinity. This is known as Traffic Information Service (TIS). Unlike TCAS, which is independent and self contained, TIS uses ground based radar information. This data is transmitted to your aircraft via a Mode S transponder. The hardware requirements necessary to benefit from TIS are a Mode S transponder and a display unit. Mode S transponders may be mandatory at some point in the future. The limitations to TIS include a radar environment requirement and it's not available in all areas of the U.S. The congested northeast does have extensive coverage. TIS is a passive system providing only traffic alerts, not any vertical escape maneuver guidance. However, TIS will display trend information on the other traffic, which TCAS doesn't do. Basically, you see what the ATC controller sees. If you have the means to take advantage of these newly available collision avoidance devices, they will aid in your detection of conflicting traffic. At the very least, make sure your transponder is on, so that other aircraft collision avoidance devices can "see" you.



Airliners and larger commuter aircraft with passenger seat capacity greater than 30 are now equipped with TCAS. In order for TCAS to provide alerts and advisories, the conflicting aircraft must have an operational transponder. A Resolution Advisory (RA), which is the active vertical guidance provided by TCAS, requires the conflicting aircraft to have Mode C altitude reporting capability. **TCAS is blind to aircraft without a transponder or with their transponder turned off.**

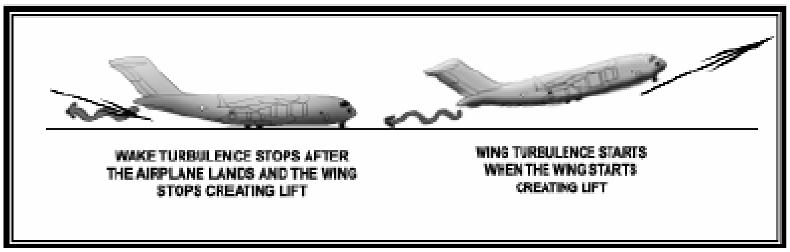
AIM 4-4-15. Traffic Alert and Collision Avoidance System (TCAS I & II) paragraph
(b) emphasizes that *"TCAS does not alter or diminish the pilot's basic authority and responsibility to ensure safe flight. Since TCAS does not respond to aircraft which are not transponder equipped or aircraft with a transponder failure, TCAS alone does not ensure safe separation in every case."* TCAS should be regarded as a tool to aid in collision avoidance, not as a replacement for an effective scan. When used properly, TCAS will not only guide the pilot through a vertical avoidance maneuver, it affords a means of early detection allowing the pilot to request an avoidance vector before triggering an RA.

As a GA pilot, you're probably wondering what does TCAS have to do with me? First of all, knowing the basics of TCAS, will assist you when flying in congested areas shared by the larger aircraft and you'll realize *how important it is to have your transponder on.* Secondly, collision avoidance technology is finding its way to the GA market and is becoming more capable and more affordable. This publication will not recommend a particular company’s product, but inform you that there are many collision avoidance devices on the market for the GA pilot.

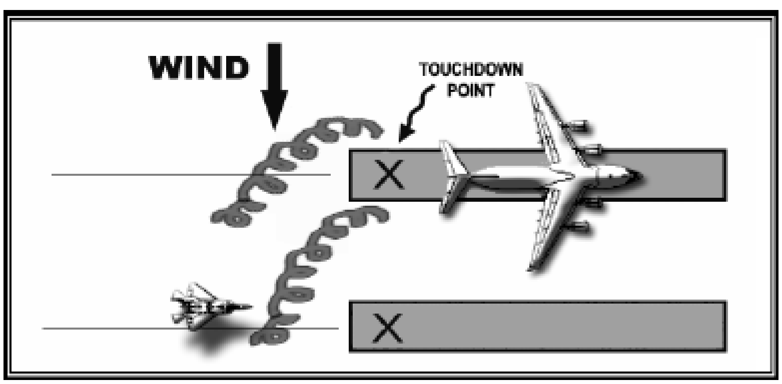
MID-AIR COLLISION AVOIDANCE is the responsibility of everyone who flies an aircraft. The advances in radar technology have reduced the likelihood of mid-air collisions but the system is not foolproof. Situational awareness and knowing who and where potential mid-air collisions can happen is a huge step in flying safe and mishap free.

CAUTION: WAKE TURBULENCE!

Wake vortices are formed any time an airfoil is producing lift. The pressure differential between the upper and lower wing surfaces triggers the rollup of the airflow aft of the wing resulting in swirling air masses trailing downstream of the wingtips. Viewed from behind the generating aircraft, the left vortex rotates clockwise and the right vortex rotates counterclockwise. The intensity of the vortex is a function of aircraft weight and configuration (flap setting etc.). The strongest vortices are produced by **heavy** aircraft, flying **slowly**, in a **clean** configuration. For example, a large or heavy aircraft that must reduce its speed to 250 knots below 10,000 feet and is flying in a clean configuration while descending, produces a very strong wake.

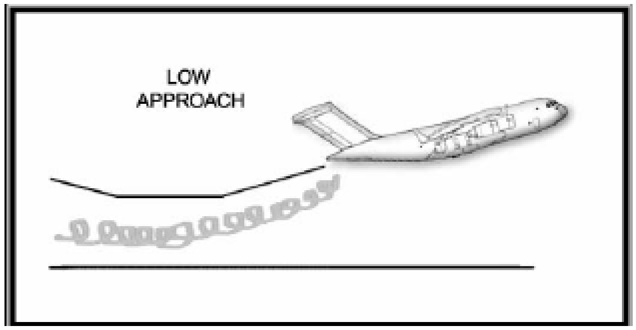


Crosswind blows wake turbulence from upwind runway into the approach path of the parallel runway. Smaller planes should cross above the possible area of turbulence and land well beyond the threshold.

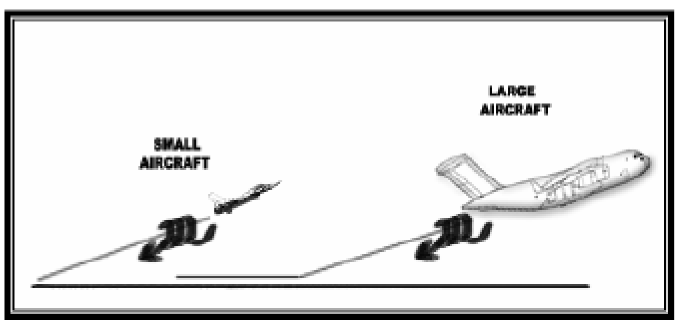


LOW/MISSED APPROACH

A large or heavy aircraft making a low missed approach or a touch-and-go-landing leaves significant wake turbulence at low level all along the runway surface. Monitor communications carefully to know when larger aircraft are going around.



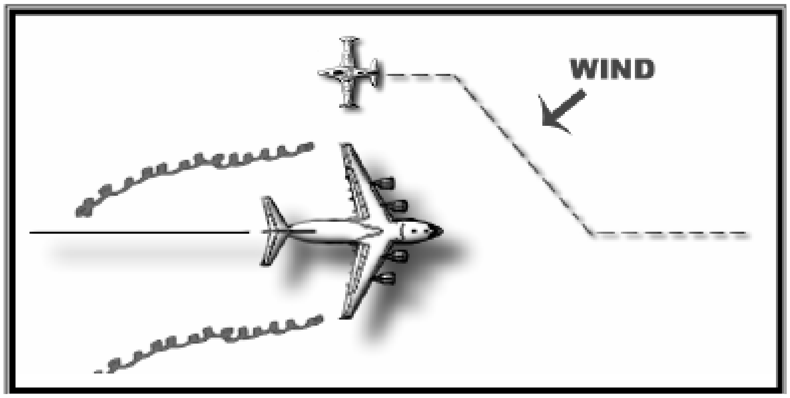
SAME RUNWAY DEPARTURE



A small aircraft departing the same runway as a large or heavy airplane should lift off before the point of the other's rotation and stay above the other aircraft's flight path. Keep this in mind if your aircraft cannot out-climb the preceding aircraft or if you are considering an intersection takeoff.

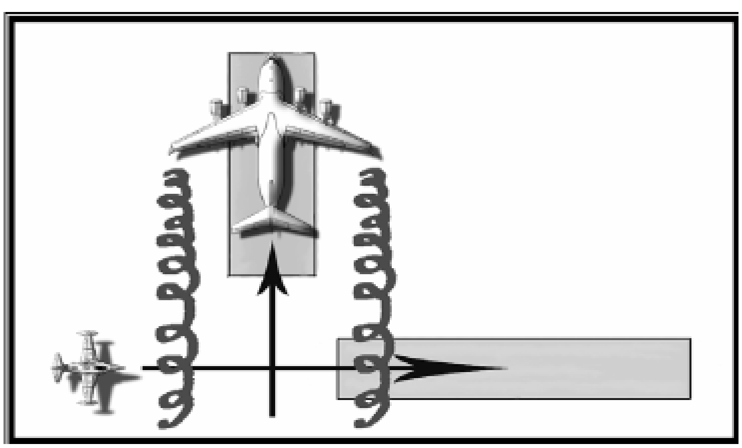
When in doubt – WAIT IT OUT.

TRACKING BELOW TURBULENCE



Small aircraft beneath larger aircraft on the same track should have at least 1000 feet vertical separation. Otherwise, the pilot of a smaller aircraft should adjust course upwind of track.

INTERSECTING RUNWAY CENTERLINES



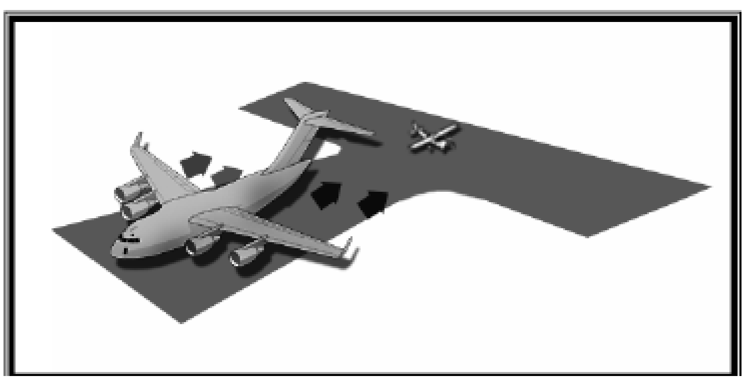
Operations on runways where centerlines intersect may cause wake turbulence from one runway to trail into the approach path of the other. A pilot should cross above the turbulence and land further down the runway.

Know and use aircraft wake turbulence separation criteria

Leading Aircraft	Following Aircraft	Separation Distance	Arrival Delay	Departure Delay
Heavy	Heavy	4 NM	2 mins	2 mins
Heavy	Medium	5 NM	2 mins	2 mins
Heavy	Light	6 NM	3 mins	2 mins
Medium	Light	5 NM	3 mins	2 mins

WATCH OUT FOR JET BLAST!

Along with aircraft wake turbulence, jet blast can also create a great deal of danger. Jet blast can up-root trees, flatten building structures, shatter windows, lift and propel heavy objects, weathercock braked airplanes, blow over lift trucks, and create other problems on airport ramps, taxiways, and runways.



What to consider:

1. Almost half of reported jet blast incidents occurred on taxiways, in run-up areas, and adjacent to or on runways—all relatively uncongested airport areas. The other half occurred on ramps, where many more such incidents might be expected because of close aircraft parking and tight maneuvering conditions.

2. 85% of the damage inflicted by jet blast was to the wings, props, flaps, and rudders of other aircraft, **especially to light aircraft weighing five-thousand pounds or less.**

3. An aircraft initiating movement from a full stop requires more power to overcome inertia and tire friction than an aircraft already in motion. Additional breakaway thrust is needed if the aircraft must also turn during the initial movement. Unless carefully managed, these power applications can result in jet blast damage.

MILITARY TRAINING ROUTES

National security largely depends on the deterrent effect of our airborne military forces. To be proficient we practice a wide range of airborne tactics. One phase of this training involves "low level" combat tactics. The required maneuvers and high speeds make the see-and-avoid aspect of VFR flight much more difficult and require increased vigilance when flying through these operating areas. In an effort to ensure the greatest practical level of safety for all flight operations (military and civilian), the Military Training Route (MTR) program was developed.

Generally, MTRs are established below 10,000 feet MSL for operations at speeds in excess of 250 knots. A variety of aircraft fly these routes and operate either VFR or IFR at speeds up to 500 KIAS and altitudes from 300 feet AGL to several thousand feet. Charleston C-17 aircraft most commonly use the following MTRs: **IR035**, **IR036**, and **VR1041**. You can see these on the enclosed map. MTRs with four numbers **(**e.g. VR1041, etc) identify MTRs with no segment above 1,500 feet AGL. MTRs that include one or more segments above 1,500 AGL are identified by three numbers (e.g. IR036, IR035, etc.). VR1041 runs along the South Carolina coast. The coastline can be extremely hazardous! Besides military aircraft flying on VR1041, be on the lookout for sightseeing civil traffic, U.S. Coast Guard helicopters, banner-towing aircraft, and parasailing.

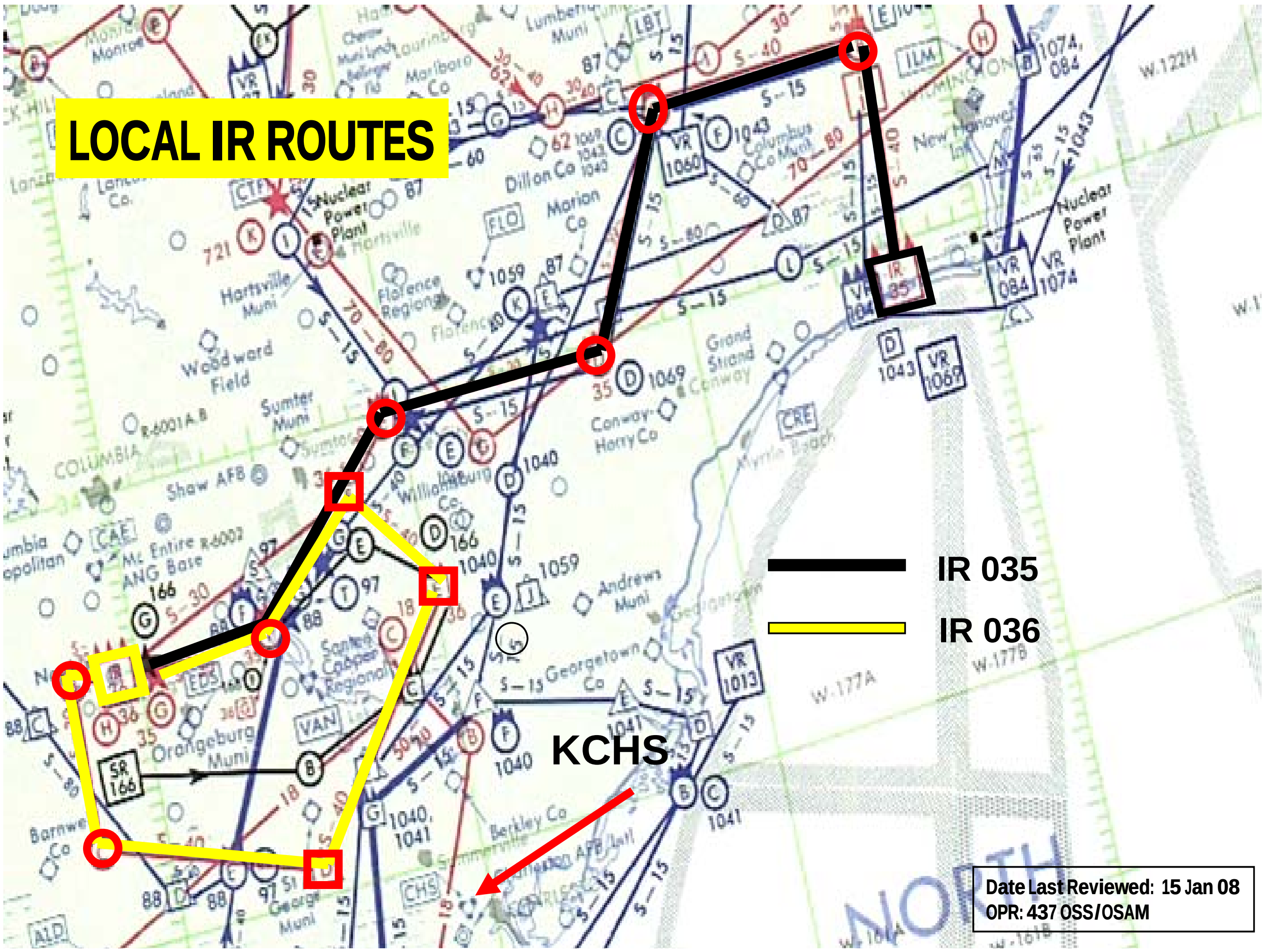
Non-participating aircraft are not prohibited from flying within an MTR but are encouraged to limit the time they operate within them. Exercise extreme caution when flying through or near these routes. Pilots should contact a Flight Service Station (FSS) within 100 NM of a MTR to obtain current information on route usage. The information available includes: time of scheduled activity, altitudes in use, and route width.

Route widths can vary along the MTR and may extend several miles on either side of the charted centerline depicted on sectional charts. Military aircraft conducting low level training can be anywhere within a MTR's structure. Aircraft will rarely be on the centerline or at a constant altitude when VFR conditions exist.

When requesting MTR information, give the FSS your position, route of flight, and destination. This will permit the FSS specialist to identify the MTRs along your intended flight path. When operating near an MTR, the only means of separation between you and aircraft using the route is

See And Avoid

COMMONLY FLOWN MTRs



MILITARY TRAINING ROUTE TO-DO LIST

1. While flight planning, carefully check charts for the presence of MTRs and avoid them if possible.

2. Since only the route centerline of an MTR is depicted on sectional charts, military aircraft may be miles on either side of centerline within the route corridor. Be especially vigilant anywhere near a charted route centerline.

3. Contact the nearest Flight Service Station for planned military activity along a route.

4. Operate through a MTR above 1,500 feet AGL.

5. Cross an MTR at 90 degrees to minimize time spent within the route.

6. If you see a military aircraft, assume he does not see you. Take action to avoid coming within 500 feet of that aircraft and within 1000 feet below the aircraft's flight path.

7. If you see a military aircraft, look for others. Many military aircraft fly MTRs in formation.

COLLISION AVOIDANCE TIPS

1. Clear constantly for other aircraft, both visually and over the radio.
2. Know where high-density traffic areas are.
3. Obtain an IFR clearance or participate in radar flight following whenever possible and continue to practice “see and avoid” at all times.
4. Use landing lights at lower altitudes, especially when near airports.
5. Announce your intentions on UNICOM and use standard traffic pattern procedures at uncontrolled airfields
6. Always use your Mode C transponder.
7. Use the appropriate hemispherical altitudes and don’t let your altitude “wander.”
8. Fly as high as possible.
9. Keep your windows and windscreen clean and clear. A bug on the windscreen can obstruct aircraft coming your way.
10. Properly manage tasks in the air. A cockpit gets very busy. Learn the proper methods to reduce workload demands and time crunches.
11. Don’t get complacent during instruction! Instructors make mistakes too. Many mid-air collisions occur during periods of instruction or supervision.
12. When flying at night avoid using white light in the cockpit. White light, even if used momentarily, disrupts your night vision. Use flashlights with red or green lenses in the cockpit.
13. Beware of wake turbulence. Especially watch out for heavy aircraft.
14. Understand the limitations of your eyes and use proper visual scanning techniques. If another aircraft appears to have no relative motion but is increasing in size, it is on a collision course with you.
15. Clear before and during all climbs, descents, and turns.
16. Above all, **AVOID COMPLACENCY!** There is no guarantee that everyone is flying by the rules or that everyone is where they are supposed to be. **SEE AND BE SEEN!**

MILITARY AIRCRAFT FREQUENTLY FLYING IN THE CHARLESTON AREA

BOEING C-17A "GLOBEMASTER III"

SPEEDS		**DIMENSIONS**	
Departure:	**200 KIAS**	**Length:**	**174 Feet**
Local Area:	**250 KIAS**	**Wingspan:**	**170 Feet**
Low Alt:	**250 KIAS**	**Height:**	**55 Feet**

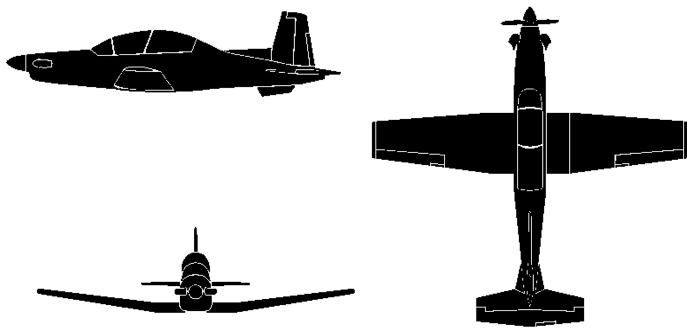
LOCKHEED C-130 “HERCULES”

SPEEDS		**DIMENSIONS**	
Departure:	**200 KIAS**	**Length:**	**100 Feet**
Local Area:	**200 KIAS**	**Wingspan:**	**133 Feet**
Low Alt:	**220 KIAS**	**Height:**	**39 Feet**

LOCKHEED C-5A/B "GALAXY"

SPEEDS		DIMENSIONS	
Departure:	200 KIAS	Length:	248 Feet
Local Area:	250 KIAS	Wingspan:	223 Feet
		Height:	65 Feet

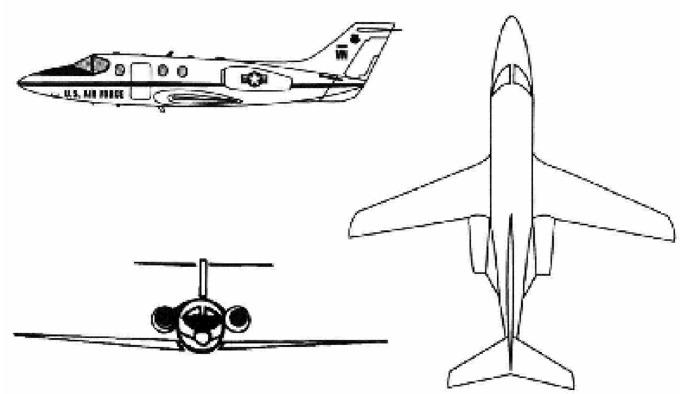
RAYTHEON T-6A “TEXAN II”



Crew: 1-2
Engine: Pratt & Whitney PT6A-68
Dimensions: Wingspan: 33’3’’ Length: 33’4’’
Weight: 6,500 lbs max
Speeds: Patterns: 200 KIAS Max: 300 KIAS

The T-6A Texan II is a single-engine turboprop airplane used by both the Air Force and the Navy for training student pilots in the fundamentals of flying. The T-6 is painted with the upper half white and the lower half blue.

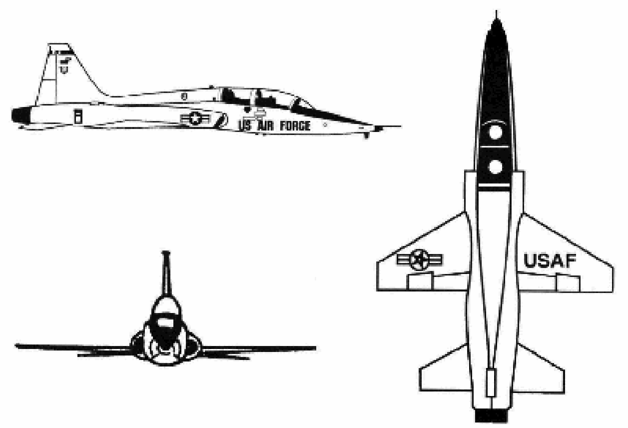
BEECHCRAFT T-1A “JAYHAWK”



Crew: 3
Engines: Twin Turbofan
Dimensions: Wing Span: 43’8”
Length: 48’5”
Weight: 16,300 lbs
Speeds: Patterns 100-250 KIAS
Max 330 KIAS

The T-1 is the Air Force’s trainer for future pilots entering the tanker/transport world. The T-1 is TCAS equipped, which provides collision avoidance with other aircraft squawking an IFF code. The T-1 is either completely white or grey in color, making it difficult to see.

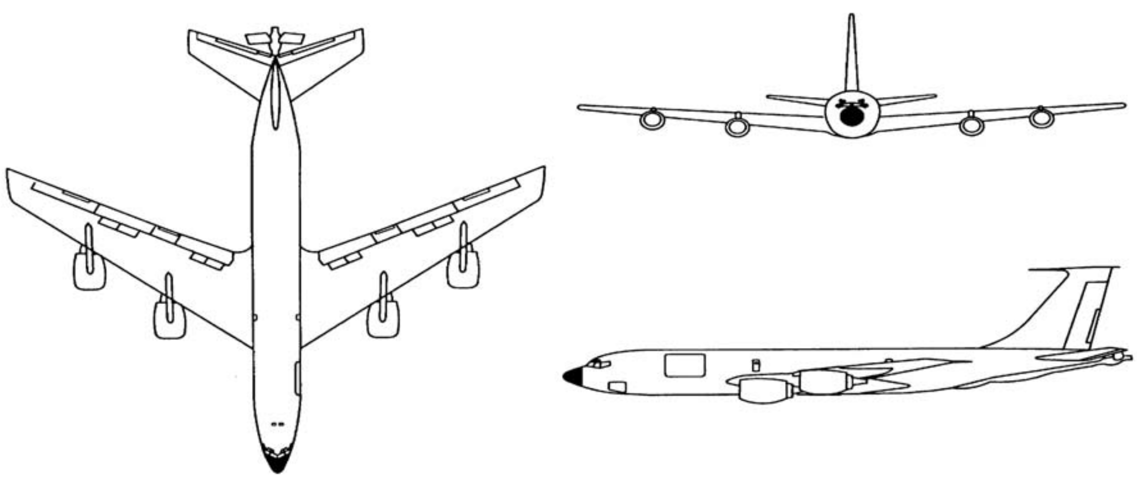
NORTHROP T-38A "TALON"



Crew: 2
Engines: Twin Afterburning Turbojets
Dimensions: Wingspan: 25'3"
Length: 46'4"
Weight: 12,500 lbs
Speeds: Patterns: 155-300 KIAS
Max: 725 KIAS

The T-38 is the primary trainer for those future pilots entering the fighter/bomber world. The T-38 is gray camouflage and has an extremely small frontal area. This, combined with its high speed, makes it especially difficult to see when flying.

BOEING KC-135R/T "STRATOTANKER"



Crew: 3-4
Engines: 4 Hi-bypass Turbofans
Dimensions: Wingspan: 130'10" Length: 128'10"
Weight: 125,000 – 322,500 lbs
Speeds: Patterns: 140-250 KIAS Max: 0.9 Mach

The KC-135 is the primary air-refueling platform of the U.S. Air Force. It is painted a dark gray. McConnell KC-135's are equipped with TCAS, which provides collision avoidance with other aircraft squawking an IFF code. The KC-135 is considered a "Heavy" and requires wake turbulence separation.

OTHER FREQUENTLY SEEN MILITARY AIRCRAFT

Antonov 124

F/A-18 Hornet

A-10

F-16

Other Aircraft of Concern in the Charleston AFB Local Area

Bombardier Challengers executive jets
C-40s and other **Boeing-737s**
KC/RC/EC-135s and other **Boeing-707 variants**
Boeing-757 C-32s
C-21A Lear Jets
E-4Bs and other **Boeing-747s**
Boeing 767s
P-3
EA6B
H-60 Blackhawks

RECENT NEAR MID-AIR COLLISIONS IN THE CHARLESTON AFB/NORTH FIELD AREA

Oct 2007: Cessna cleared to land on Runway 33 and C-17 cleared for takeoff. Cessna performed a go-around

Dec 2007: An unidentified helicopter entered the Class E airspace of North Field without talking to Tower. The helicopter passed in front of the C-17 causing the C-17 to perform a Go-Around.

Mar 2008: Cement truck entered runway without permisison from tower causing a Citation to perform a go-around

Apr 2008: C-17 operating on IR-35 experieced a VFR airplane climb into their flight path causing hte C-17 to perform a climb to avoid the traffic.

Oct 2008: C-17 being vectored to final received a resolution advisory from pop-up VFR traffic.

Oct 2008: A sweeper crossed runway 03 without permission from tower.

IMPORTANT TELEPHONE NUMBERS

437 AW Wing Safety Office	**(843) 963-5600**
437 AW Base Operations	**(843) 963-3024/3026**
Charleston Approach Control	**(843) 414-2800/2808**
Charleston Tower Control	**(843) 414-2809**
North Auxiliary Airfield	**(843) 963-9978**
Columbia, SC Flight Standards District Office	**(803) 765-5931**

This brochure contains information regarding mid-air collision avoidance, wake turbulence, jet blast awareness, and the operations at Charleston AFB. If you have questions concerning these topics, contact the Charleston AFB Flight Safety office at (843) 963-5600 or e-mail us at 437aw.se@charleston.af.mil.